Impact of service orientation at the business level

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In the current business environment in which companies are under increasing pressure not only to increase revenue but also to respond quickly to changing market conditions, companies will be successful only if they transform themselves and become on demand businesses. In this paper we describe the changes needed to effect this transformation, and in particular, we describe the important role played by componentization and by service orientation. We discuss the way componentization enables a business to operate in a value net, a network of partnerships with customers and suppliers supported by real-time information flows and information technology systems. We also describe the need for service orientation to achieve seamless integration of business components. We illustrate these ideas with a case study from the rental car business. Finally, we describe IBM activities in this area and the resulting methods and tools that help businesses deal with these challenges.

INTRODUCTION

The business environment is undergoing a dramatic change. Competition from traditional and nontraditional players, emergence of a multitude of delivery channels, a plethora of regulatory and governmental compliance requirements, and demands for more flexibility and agility, to name a few, influence business design and execution. Growth is returning to the agenda of CEOs, and most CEOs expect their enterprises to reach revenue growth by becoming more responsive.[1]

The demand for innovation, flexibility, and shorter time to market for new products and the desire to create new revenue sources has led to rethinking industry structures. Novel ideas, promoting the deconstruction (unbundling) of the corporation and enabling it to focus on its core business competencies, find increasingly broad acceptance.[2] Such deconstruction of the corporation naturally led to the emergence of collaborating ecosystems.[3] The manufacturing industry discovered the power of specialization and collaboration first and took it to new heights, closely followed by the electronics industry.[4] The services industry, perhaps as a backlash against unbridled consolidation, is now actively pursuing deconstruction. An IT (information technology) professional would observe that corporations are naturally becoming componentized.

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What is described here is a business that is able to recognize change as it is occurring and react appropriately, ahead of the competition, and keep pace with the demands of its customers, value-net partners, and employees alike. In trying to achieve this state, the business will need to leverage technology to the fullest. We call such a business an "on demand business." Fundamentally, becoming an on demand business is equivalent to achieving total business flexibility. Two important enablers contribute to the realization by an enterprise of this vision of on demand—componentization and service orientation.

The notion of *componentization* allows an enterprise to deconstruct, analyze, and then reconstruct into value nets, in which partnerships with customers and suppliers operate in a network supported by real-time information flows and integrated IT systems. The process of deconstruction/reconstruction is realized through business components, which correspond to distinct business functions. In the on demand environment, the component-based firm links its components efficiently and seamlessly both internally and across the firm's boundaries with best-of-breed components provided by external partners.

Nonetheless, componentization by itself is not sufficient. Interactions between business components need to be seamlessly and tightly integrated across the value net. The need for flexibility across the value net requires that the component network be flexible; that is, the enterprise can "in-source" an outsourced component and vice versa; replace, on demand, a current partner with a different partner; change the terms of the contract between the two components, and so on.

The key to seamless integration between business components is *service orientation*. As defined above, each business component serves a unique purpose and provides one or more business services for consumption by other business components. The component that consumes a business service offered by another business component is oblivious to *how* the provider creates the business service. Service interactions between business components are governed by business-level agreements and contracts, which cover items such as cost structures, service levels, and so on. The information technologies that evolved in support of service orientation, first Web services and then service-oriented architecture (SOA),[5,6] have proven to be well-suited to business transformation in the enterprise.

The rest of the paper is organized as follows. In the next section, "The service-oriented enterprise," we describe our vision of an enterprise able to deal with the challenges of the emerging business environment. We discuss the changes necessary to bring about the service-oriented enterprise, namely componentization, evolving the business ecosystem, changing business processes, and addressing organizational issues. In the following section, "An on demand scenario," we provide a case study that illustrates how componentization and service orientation can enable an enterprise to react quickly to a marketplace need. Then, in the section "IBM activities," we briefly describe the way IBM helps businesses to implement service-oriented enterprises. We conclude the paper with a brief summary.

THE SERVICE-ORIENTED ENTERPRISE

Given the need for the deconstruction of enterprises, we now look at how such transformations can take place. Businesses need to focus on their core business competencies that differentiate them from their competitors. A strategic analysis could then reveal which capabilities are best done within and which can be outsourced to a partner to the advantage of both parties. Thus, businesses should view themselves as a federation of capabilities that collaborate with other enterprises within a business "ecosystem." In other words, the deconstruction transforms the enterprise into a collection of smaller and autonomous business components that interact with similar entities within the business ecosystem. This transformation is referred to as the componentization of the business.

The componentization of the business leads to an increase in the number of interacting elements, which means that more effort is invested in logistics. Complexity can be controlled by designing business functions as well-defined services. Thus we see the emergence of the service-oriented enterprise.

Transforming an enterprise into a service-oriented enterprise involves business challenges that are more difficult to overcome than the technological challenges associated with implementing an SOA infrastructure. The concept of a service-oriented

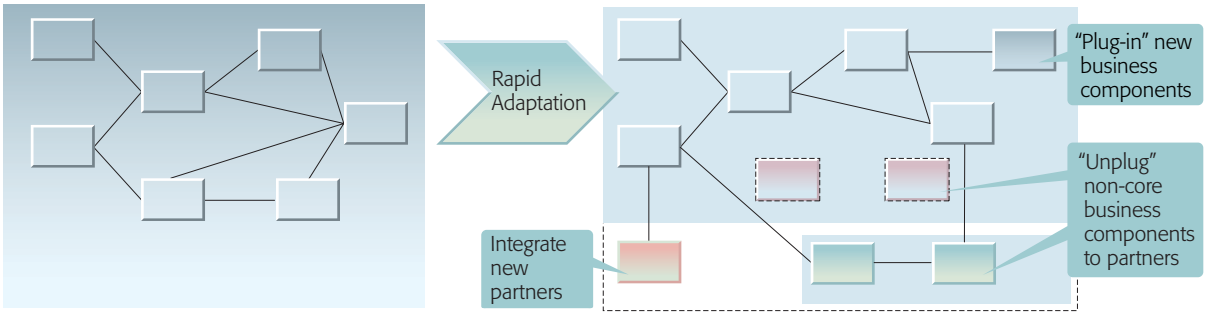

Figure 1
A component-based business adapting to business needs

business is simple to understand; the realization is complex and requires research and innovation in many areas. In this section we describe some of the steps required to realize a service-oriented enterprise.

We first examine the componentization of a business by describing the reasons for componentization and the properties of a component-based business. Then we discuss a number of other business transformations required for creating a service-oriented enterprise: evolving the business ecosystem, changes to business processes, and addressing organizational issues.

Componentization

Figure 1 is a very simple illustration of a component-based business and its ability to adapt to business needs through changes to its component structure. The component structure is illustrated as a network of interconnecting components. As shown in Figure 1, the component structure can be changed to accommodate the "plugging-in" of new components, the "unplugging" of other components (possibly those peripheral to the main business) and setting up replacement components from a business partner, and the integration of a component from a business partner. Thus a component-based business is, by nature, very flexible.

This illustration assumes that the business components can be plugged in or unplugged with relative ease. Because a business component involves people, resources, technology, and know-how, the addition or removal of components has implications for all these aspects of the business component. It is easily inferred that these will not be achievable tasks unless the structure of the business component, its responsibilities, and its collaboration with other components through well-defined interfaces are understood and clearly defined. In other words, a business component is a part of an enterprise that has the potential to operate independently—even as a separate company, or as part of another company.

Such flexibility in reshaping the way the business operates requires a highly structured, architectural view of the business. An analogy can be made with IT. IT architecture proved to be successful in providing an analytical and decision-making framework for a sequence of new initiatives or changes, at the same time ensuring design integrity and stability. Furthermore, the expectation that the new business construct will be enabled by IT further motivates the creation of the architectural view of the business and its linking to the architectural view of IT.

The Component Business Model (CBM) is a method used by the IBM business consulting community to methodically create a structured representation of the business as an organized collection of business components. It provides a foundation for discovering both business inefficiencies and the transformations required to meet other strategic goals. CBM will be described in greater detail in the section "Realizing the service-oriented enterprise: The IBM approach."

A business offers goods or services in exchange for money or for other goods or services. A business component should behave similarly if it is to operate independently and exchange its goods and services for payment from other components or external suppliers. The term *business service* is used to mean the goods or services that a business component

offers to other—internal or external—business components.

A more complete characterization of a business component includes:

- *Business Purpose*—The definition of the basic value provided by the component and the reasons for component's existence (in a manner of speaking, a business component is what it does).
- *Activities*—The collection of activities performed within the boundaries of the business component.
- *Resources*—The people, the know-how, and all other tangible and intangible assets that the business component needs in order to operate.
- *Governance*—The management mechanisms that the business component needs for autonomous operations, including metrics and procedures for motivation, performance, and accountability.
- *Services*—All services offered and consumed by the business component. Service orientation enables the definition of components with well-defined boundaries. To achieve the desired business outcome, these components collaborate with other components through services. Thus, service orientation is a required element of the componentized business. Such interactions are subject to service-level agreements (SLAs) that set norms for the delivery of services.

Evolving the business ecosystem

We discuss here three characteristics of the service-oriented enterprise related to the evolution of the business ecosystem: the elevation of IT's importance beyond a supporting role, the adoption of value nets, and the logical separation of the business function from its implementation.

The elevation of IT's importance

In the on demand economy, strategic business changes, including business process optimization, are tightly linked to IT solutions so that IT importance grows beyond a supporting role. IT is not a mere enabler for business activity anymore. There are cases in which IT capabilities drive business strategy or even comprise the foundation of the business model. Some of the businesses in the latter category are Amazon.com Inc., eBay Inc., Google Inc., and Yahoo! Inc.

Even in enterprises whose business models do not depend mostly on IT capabilities, a new generation of IT plays a strategic role in business transformation, including creations of new sources of business revenue. For example, Federazione Italiana Giuoco Calcio (Federation, for short), Italy's football association, had been relying for years on FAX, telephone, and postal mail to communicate with the country's 25,000 referees, with less than satisfactory results. Frequently, either a referee didn't receive an assignment or the Federation didn't receive a response from the referee. A new wireless solution solved the administrative difficulties at the same time reducing annual costs by more than three million euros. Equally significant, as a result of adopting the new technology, the Federation has identified a new business opportunity, which is selling the real-time scores of the football matches to the media.[7]

Value nets

Much has been written about recent methods for creating business value by shifting from the value-chain model[8] to the value-net model.[9] In the traditional value-chain model, businesses convert raw material into finished goods in production-line fashion, with value added by every step of the production line. Ever increasing customer demands for faster delivery and more choices, combined with e-commerce technologies, made the older supply chain obsolete. Successful enterprises now focus on creating value nets, in which partnerships with customers and suppliers operate in a network supported by real-time information flows and integrated IT systems. In value nets, information is moving in real time across the cooperating businesses, the relationships among the partners is dynamic and varies with changing conditions, and the operating targets of the business include not just efficiency but also agility. In value nets, the business value is created by businesses and their suppliers, buyers, and partners through the combination and enhancement of services provided by all participants.

Logical separation of the business function from its implementation

One of the well-known software engineering principles, "separation of concerns,"[10] dictates that functional responsibilities be distributed among components with little overlap. In service-oriented business, a similar separation of concerns results in the logical separation of the business function (service) from its fulfillment (implementation).

Consider, for example, a financial services enterprise that might perform some functions—such as customer credit verification and reporting, billing, customer call center, or fund transfers—based on services negotiated with external providers. The consumer views this enterprise as providing a service that combines, and perhaps enhances, a collection of services provided by others. In fact, the consumer may not even realize or care that services are fulfilled by multiple providers. This separation of business function from its implementation (among other things) enables enterprises to change service providers based on service performance, price, and other, mostly nonfunctional, attributes.

Changing business processes

We discuss here two aspects of the service-oriented enterprise related to business processes: the role of composite services and the ascent of dynamic processes.

Role of composite services

As described earlier, in the value-chain economy, every major subprocess or step adds value to the product of a previous step. These steps, assembled in a production-line style, although with some iterations and parallel streams, deliver cumulative results in a largely sequential workflow. In the service economy, the service-oriented enterprise has the option of assembling its processes by using services provided by others. In addition, business processes can be created by using a composition of existing services in a new enhanced service or a *meta-service*.[5] These composite services can be viewed as combining "products" of parallel production lines. The service composition is a powerful concept—the composite services may be recursively combined to produce even more services, offering new functionality and satisfying diverse nonfunctional requirements of potential service consumers. Services are combined according to certain business logic to deliver specific functionality and quality of service. Each service has an associated declarative policy that specifies quality of service, availability, and other attributes necessary to meet the overall business process goal.

Ascent of dynamic processes

In addition to being sequential, traditional processes are also synchronous—that is, processing at each step depends on and waits for the results of the previous step. The new process design (also known as the "choreography" of services) may be dynamic, that is, the choice of subsequent steps may be based on the full or even partial results of previous steps rather than on a predefined static sequence.

The creation of a new service is not just a combination of several existing services. It may involve modification or enhancement of existing services, and these may include steps involving human intervention. For example, human intervention might be required when an unexpected exception occurs and a decision that could not be preprogrammed must be made.

This change in process design requires new approaches to process modeling. New models need to be able to support more than just process decomposition. New concepts, modeling constructs, and tools must be able to capture processes with flexible sequences that are result-based rather than sequential with fixed decision points. Initial work is being done in this area, but not much has been published.

The emerging business-process-management discipline promises to treat the results of process execution as real-time data for the process itself. The availability of real-time process execution information will provide businesses an opportunity to address a wide range of challenges and to improve processes in nearly real time. Consider, for example, the availability of current and accurate information on fleet location, retail inventory, or shipments of goods. This kind of information represents business intelligence of the "closed-loop" kind, never available before. Availability of this information enables improved asset control, better process automation, and enhanced tracking of business activity. Achieving successful process design through a composition of services requires the support of new families of tools such as process engines and rule engines. The description of such tools is beyond the scope of this paper.

Addressing organizational issues

We cover here some characteristics of the service-oriented enterprise related to organizational matters: the organizational changes that are associated with the transition to a service-oriented enterprise, the emergence of service intermediaries, and the increased importance of a common interpretation of service definitions.

Change in organizational structure and roles

If organizational structures remain unchanged, the realization of the enterprise's SOA will be suboptimal. The transition to a service-oriented enterprise requires loosely coupled organizations that are based on the role definitions of service consumers and service providers and the understanding of their relationships. Although the relationships within each unit may remain hierarchical, the relationships between units are not; they are based on the provision and consumption of services.

In most effective enterprises, funding of IT development and operation will also change. Because services are enterprise assets, funding models need to shift from being based on lines of business to being based on the enterprise or, perhaps, on consumption. For example, service consumption might be metered and service life-cycle operational costs might be allocated to consuming units based on their consumption rates.

In a deconstructed enterprise, business units may not have responsibility for a complete end-to-end process, but rather for services that enable the operation of other processes. Thus, the coordination and agreements between units must also be service-based. The basis for evaluation of units, teams, and even individuals will shift to delivery of service (Reference 11 [in this issue] addresses in detail the changes in organizations, management style, and even individual behavior in the service-oriented enterprise).

Emergence of service intermediaries

In traditional manufacturing that involves raw materials, enterprises are concerned with their supply chain, and especially with the reliable and timely delivery of raw materials. Their focus is on managing the risk of possible supply interruptions and delays. Similarly, service-oriented enterprises must be concerned with possible interruption of services. Services play the role of raw material in the service-oriented business.

Negotiating with and changing service providers must occur much faster than in the traditional economy. This requirement to accelerate negotiations will lead to the emergence of service intermediaries. In an environment in which consumers have the option of switching to a different service provider, service providers have the incentive to cultivate customer trust as a preventive measure.[12] Service intermediaries can help create trust by prequalifying service providers based on past experiences and other criteria. Prequalification of service providers is one of several roles that service intermediaries might play. There are other roles in which intermediaries act as liaisons between providers, consumers, or even other intermediaries. These roles and responsibilities include the following:

- *Registrar*—Provides registration (publication) of services, inquiries, and reports of commercially available services
- *Broker*—Finds the best (registered) service based on consumer-provided criteria
- *Reseller*—Provides proxy service for a service provider
- *Biller*—Provides invoicing/collecting service between consumers, providers, and other intermediaries
- *Authenticator*—Ensures identification of service consumers
- *Service Aggregator*—Aggregates commercially available specialized services
- *Host*—Provides physical hosting of the commercially available service (external to service provider)

There certainly will be others. The large number of intermediary roles might complicate transactions between parties. To reduce the number of interactions and contracts between parties, superintermediaries, which combine multiple roles, will evolve.

Increased importance of a common interpretation of service definitions

The presence of multiple agents (service consumers, service producers, and service intermediaries) in the service-oriented environment requires that there be a common interpretation of service definitions (both static definitions and runtime characteristics). Such a common interpretation of service definitions is also required when multiple providers offer similar services (e.g., customer credit verification services). The requirements for a common industry semantics of service definitions apply within each business domain (e.g., insurance, sales, and fulfillment) as well as across domains.

Table 1 summarizes the main differences between the traditional and the service-oriented enterprise.

Table 1 Comparison of a traditional enterprise with a service-oriented enterprise

	Traditional Enterprise	Service-Oriented Enterprise
Business Ecosystem		
IT role in business (business/IT alignment)	IT has supporting role ("enabler" of business activity). Business organization has the challenge to ensure that IT understands and supports business requirements.	IT plays a strategic role in business transformation, including creation of new sources of business revenue. IT systems mirror the attributes of the business they enable.
Business value creation	Value is created in each phase in the value chain (e.g., from raw goods to finished products). Business value is created mostly within the enterprise.	Real-time information moves across the value net among cooperating businesses, facilitating dynamic relationships among partners. The business value is created through services provided by participants.
Business requirements/fulfillment coupling	Business requirements are often generated and fulfilled by the same business unit/enterprise.	Logical separation of business need (service consumption) from fulfillment (service provision). The same business need can be fulfilled by multiple providers.
Business Process		
Process flow and composite services	Process flow is often sequential; value creation is cumulative and based on the value chain. Composition of services is limited	Process flow is net-like, through composition and enhancement (and often parallel execution) of existing services provided by participants in the business ecosystem.
Process design	Static, sequential flow with decision points in predefined sequence. Modeling is focused on decomposition.	Dynamic, based on execution results of subprocesses. Nearly real-time dynamic orchestration.
Organizational Issues		
Organizational structure	Hierarchical	Horizontal, network-like structure based on service consumer-service provider relationship
Intermediaries	Limited applicability	Service intermediaries are needed to accelerate negotiations and facilitate switching providers
Common interpretation of service definitions	Limited applicability	Essential in the service-oriented environment

AN ON DEMAND SCENARIO

This scenario illustrates how componentization and service orientation can enable an enterprise to react quickly to a marketplace need. The customer, a major car rental company, is referred to as Rent-a-car. References are also made to two methods developed by IBM: CBM and SOMA (Service Oriented Modeling and Architecture). More information about these methods is included in the section "Realizing the service-oriented enterprise: The IBM approach."

Overview

At the time of this scenario, Rent-a-car had an established presence in most countries of the Western Hemisphere. With IBM's help it had recently completed a significant incremental on demand transformation effort involving the Rentals and Reservations function. The effort resulted in an SOA implementation supporting a number of business processes, including Rentals and Reservations. As a result of the on demand transformation, the

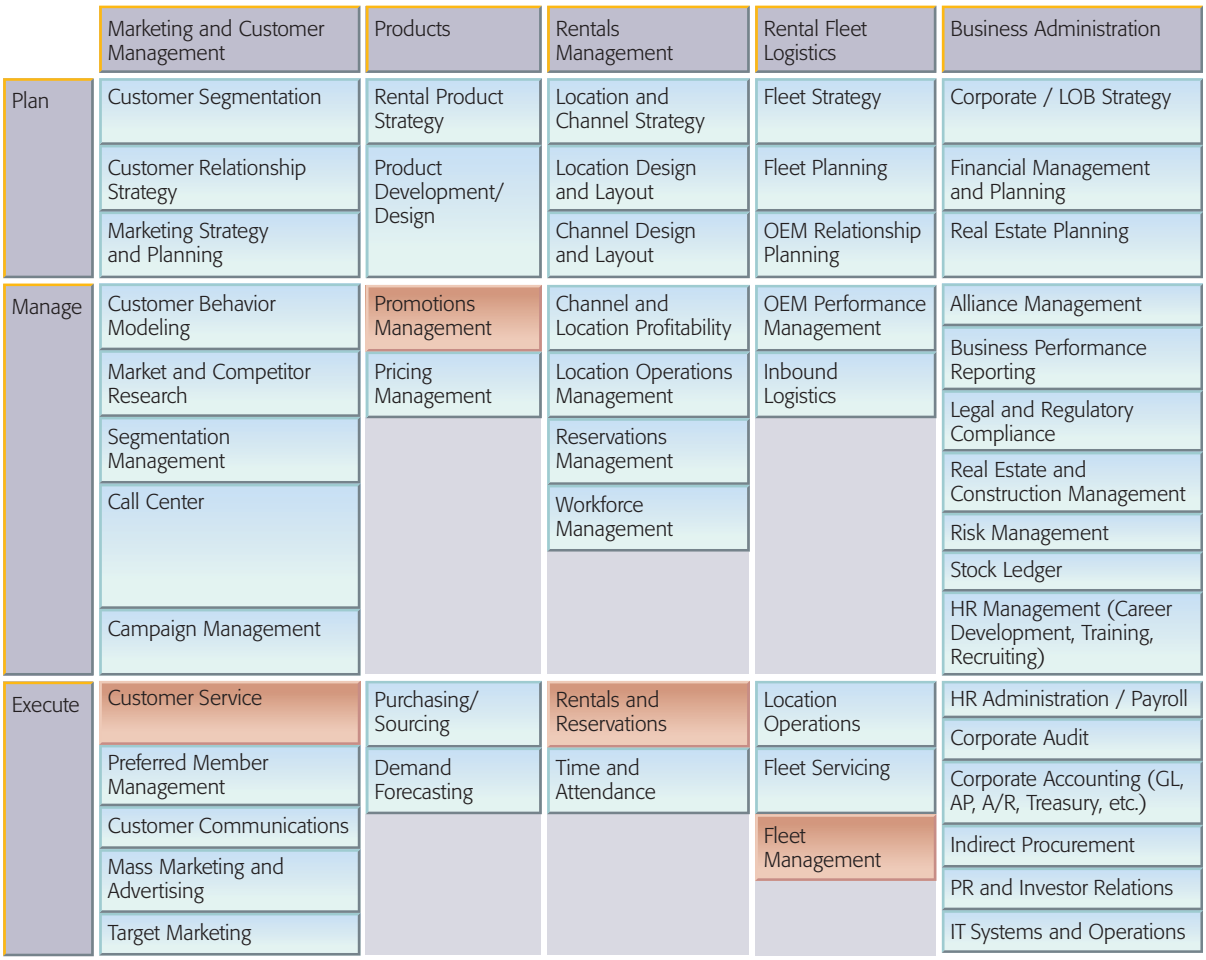

Figure 2
CBM heat map for the India operations

same processes and systems are uniformly used throughout most geographic areas, and significant efficiencies of scale have been obtained. Now, Rent-a-car plans to expand into a number of developing nations, and, in particular, India.

A survey of the Indian market revealed the following findings:

- Transportation infrastructure significantly lags behind Western Hemisphere countries.
- Significant portion of customers are travelers from outside India and do not have any interest in driving an automobile in India.
- Local customers are relatively few.
- Labor is relatively cheap, and there is a large pool of licensed drivers.
- Space in and around airports is scarce, and setting up shop at the airports would be problematic.
- India is a very attractive market due to the double-digit growth expected in the economy.

Rent-a-car decides to establish business operations in India that would offer renting of driven vehicles (with company-provided drivers).

In the traditional business model, creating an organization in a new country with these dynamics would have been very time-consuming and may have allowed other more nimble local competitors to establish a presence and capture market share. However, Rent-a-car is able to succeed by exploiting its streamlined and uniform processes and by selectively adapting them or creating new ones for the India operations. The next subsection describes how this can be achieved.

Rentals and Reservations process

As part of implementing the recent on demand transformation, Rent-a-car had created a component-based model of the enterprise (using the CBM method). ***Figure 2*** shows the so-called CBM "heat map," in which the components selected as the initial focus for the business transformation (a.k.a. "hot components") are identified. The rows represent the three types of management activity performed. *Direct* activities relate to defining policy, plans and goals, organization, and budgets and assessing overall performance. *Control* activities involve allocating tasks and resources, authorizing and decision making, and overseeing and troubleshooting. *Execute* activities relate to administering, maintaining, and operating.

The columns represent groups of related business activities that are obtained by partitioning the complete collection of functions. *Marketing and Customer Management* represents the way in which Rent-a-car plans to deal with existing and potential customers (to whom is the business going to sell). *Products* refers to all activities associated with planning, selecting, procuring, displaying, pricing, and promoting the products/services Rent-a-car intends to offers (what is the business going to sell). *Rentals Management* relates to where the products will be sold (physical location, online, phone), activities associated with rentals and reservations and management of the rental agreements (where and how is the business going to sell?). *Rental Fleet Logistics* involves acquisition of vehicles from manufacturers and their transfer to rental (how does the business manage the rental fleet?). *Business Administration* involves decisions and activities that enable and support all the other functions (how does the business support and enable itself).

As a result of prioritizing the highlighted components in Figure 2, Rentals and Reservations was selected as the primary component for the recent transformation. This component offers a set of business services and consumes a set of business services that are offered by other components (***Figure 3***).

As shown in Figure 3, Rent Vehicle is a business service offered by the Rentals and Reservations component. As shown in ***Figure 4***, it is also a business process that can be broken down into subprocesses, activities, and tasks. We refer to the

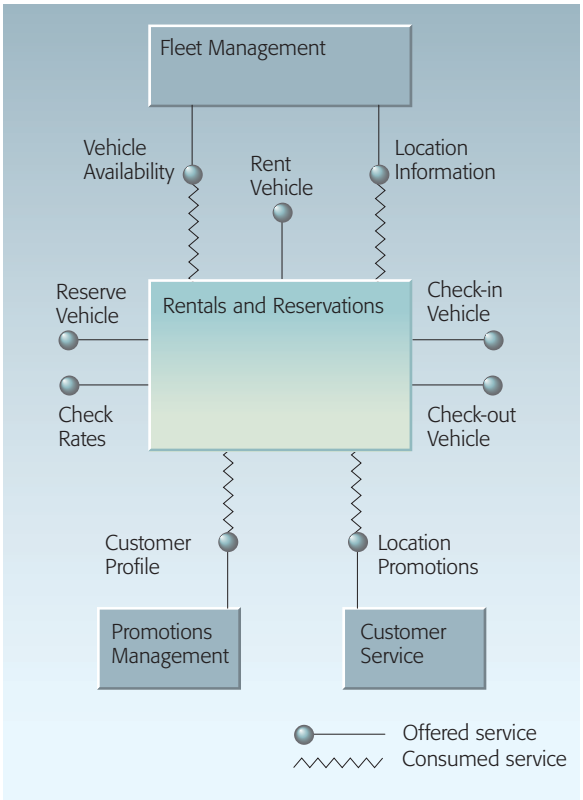

Figure 3
Rental and Reservations: offered and consumed services

diagram in Figure 4 as a *process model*. The process model represents the sequence of activities performed to accomplish a certain business function as a hierarchical representation of process steps, subprocesses, activities, and tasks. For example, the subprocess *Check Out Vehicle* is carried out by performing the following steps in sequence: locating the customer's reservation (*Locate Reservation*), modifying it as appropriate (*Modify Reservation*), converting the reservation into a rental agreement (*Create Rental Agreement*), and signing out the vehicle from the lot (*Sign Out Vehicle from Lot*). Various depictions are used throughout the industry, but that in Figure 4 is a widely used representation of a process model. ***Figure 5*** shows the Rent Vehicle process and its subprocesses. It also shows services identified for exposure (services are identified through the application of the SOMA method). Notice that some processes, identified as services for exposure, are represented as composite services. For example, Reserve Vehicle is the composite service created from Check Rates and Make Reservation.

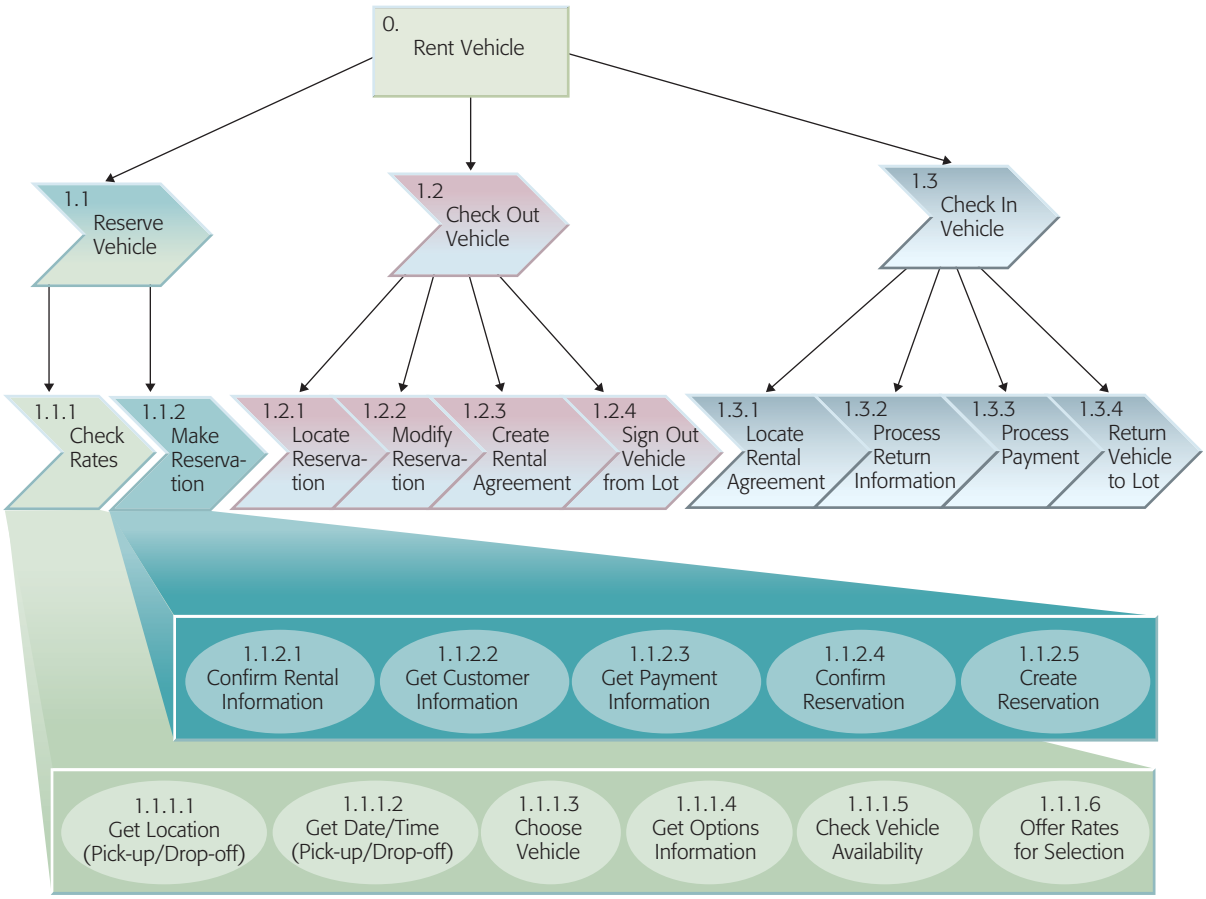

Figure 4
Rent Vehicle process model

Though the same hierarchical relationships as the process model are maintained, there are some key differences. Not every subprocess, activity, or task is a business service. Only those deemed suitable are exposed as business services, represented by a translucent bubble in Figures 5 and 6. A process can either be fully or partially realized through business services; *Rent Vehicle* and *Reserve Vehicle* are in the first category, *Check Out Vehicle*, *Check In Vehicle*, *Check Rates*, and *Make Reservation* are in the second category.

Rentals and Reservations, India operations

An analysis of the current process model against the market conditions in India identified the Check Out Vehicle process to be the one that needed modification. Instead of the customer checking out the vehicle at the Rent-a-car location, the company delivers the vehicle to the customer. This new process step 1.2 is identified as Send Vehicle to Customer, and shown in the modified service model in *Figure 6*.

Send Vehicle to Customer is a new process that consists of both automated and manual activities. Assign Driver involves both manual and automated activities, whereas Pick Up Customer is entirely manual. When the reservation is located and the rental agreement is printed, the company assigns a driver and a vehicle as required in the service contract (the driven vehicle service starts with the Pick up Customer step).

Implementation of Rent Vehicle

Because the recent on demand transformation effort produced a comprehensive service model, it is relatively easy for Rent-a-car to create a new process for Rent Vehicle by using the existing Reserve Vehicle and Check In Vehicle services. The only new business service that has to be created and deployed

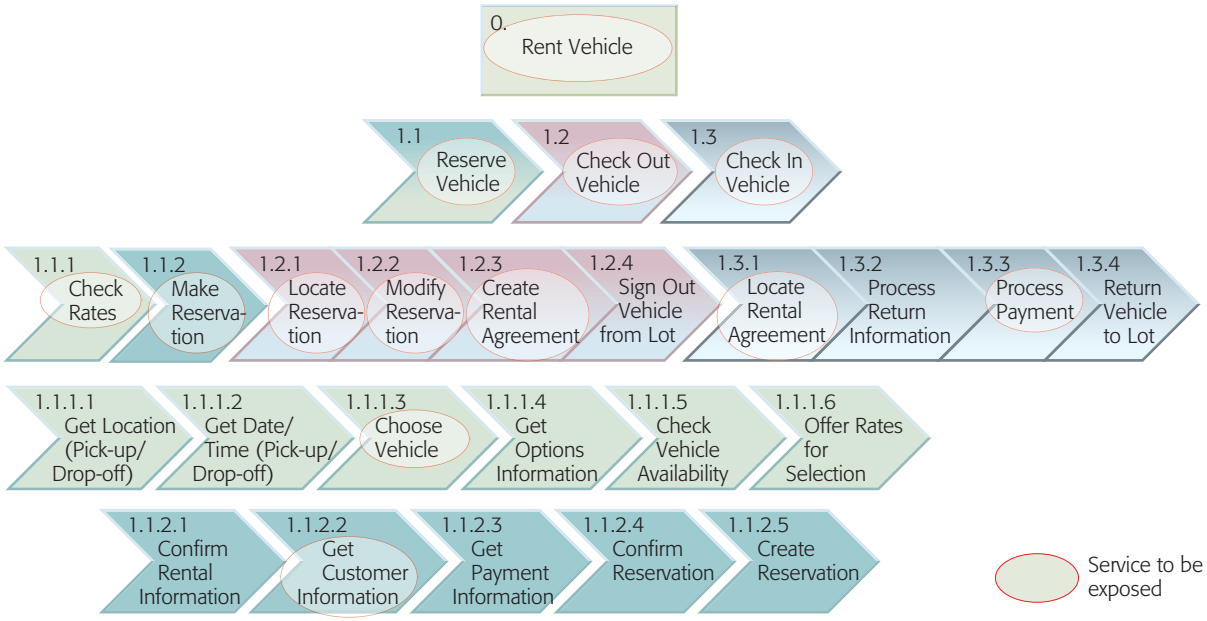

Figure 5
Rent Vehicle process with service exposure decisions

is Send Vehicle to Customer. Even that service reuses the software components that provide the functionality for Locate Reservation, Create Rental Agreement, and Sign Out Vehicle from Lot. Before deploying the business service Send Vehicle to Customer, Rent-a-car will need to ensure the service meets the quality-of-service considerations applicable to the India operations. Typical qualities of service include security, availability, and various other performance characteristics.

The efficiency gains from following such an approach are significant indeed. Instead of having to create a country-specific business and operational model from the beginning, Rent-a-car is able to leverage software assets and operational processes from its worldwide operations, modify them as necessary, and deploy a fully functional business process very quickly. From a business operations standpoint, the most substantial effort concerns managing the labor pool. As a result of the initial on demand transformation efforts, Rent-a-car is able to begin business operations in India in a relatively short time.

REALIZING THE SERVICE-ORIENTED ENTERPRISE: THE IBM APPROACH

Zisman[13] analyzes the evolution of business in recent years in parallel with the evolution of IT and describes the new challenge of establishing a tighter linkage between business strategy and IT (also referred to as "bridging the gap" between business and IT).

We submit that bridging this gap requires

1. a structured view of a business that facilitates its strategic and operational analysis and is a familiar representation to IT professionals,
2. a rigorous method to translate this structured business view to the appropriate (service-oriented) IT layer, and
3. new build and runtime technologies suited to the new IT layer.

The realization of the service-oriented enterprise as an example of the on demand business model with its increased rate and scope of change depends on the effectiveness of capturing the business execution characteristics, on mapping these into automation solutions, and on dynamically modifying the solution's characteristics based on the changing environment.

To address item 1, IBM has developed CBM (the Component Business Model), a method to create a componentized view of the business and then

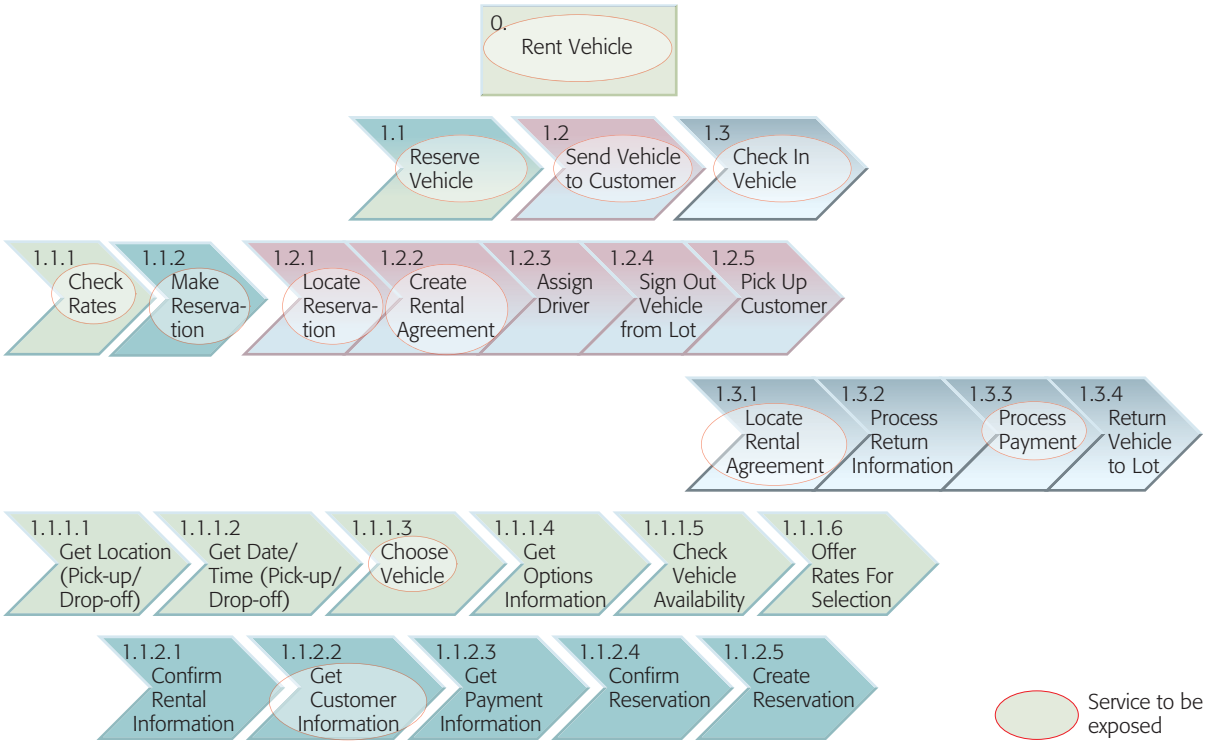

Figure 6
Rent Vehicle process, India operations

explore opportunities for transformation. For item 2, mapping the business structure to the IT layer with fidelity, IBM has developed Service Oriented Modeling and Architecture (SOMA). Finally, to address item 3, IBM has developed the build and runtime technologies needed to support SOA solutions.

The Component Business Model

CBM is a framework for analyzing and modeling a business for the purpose of organizing and grouping business activities into components. The result is a component business map, an example of which is shown in ***Figure 7***. As illustrated in the figure, activities are grouped along two coordinates, business competencies (columns) and accountability levels.

Aggregating activities by business competency leads to a componentized view of the enterprise, where the components can be characterized according to the type of business value they provide to the enterprise. Although different enterprises and industries may categorize business competencies differently, each activity should be accounted for under some business competency. Components are thus assigned to business competencies.

The accountability level characterizes the scope of decision-making authority. CBM uses three levels of accountability: directing, controlling, and executing. *Directing* is about strategy, overall direction and policy. It covers defining policy, formulating strategy, establishing guidelines, creating plans and targets, assessing performance, and so on. *Controlling* is about monitoring and tactical decision making and covers managing exceptions, tracking progress against the plan, categorizing and prioritizing work, and so on. *Executing* is about carrying out the work plan and covers day-to-day operations, such as production and maintenance.

CBM can help analyze the business and develop a componentized view of how the enterprise may evolve. The transformation is achieved in three steps. First, a model of the current business is developed, provided one does not already exist. The model is built from items such as organization charts, cost and value drivers, job responsibilities and activities, staffing policies, key performance

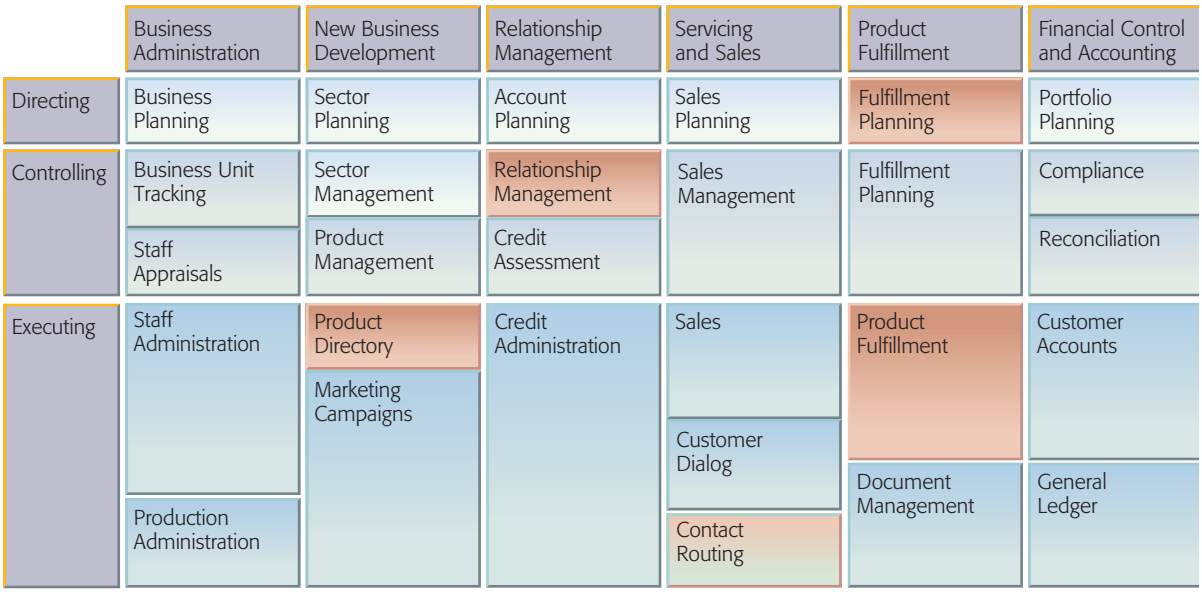

Figure 7
Component business map

metrics, and the location and ownership of existing processes. Second, using the business model, competencies and activities are grouped into components, which are then examined for coherence and consistency. Third, the components are organized into a component business map, and the set of "hot" components (candidates for further action) is selected and prioritized.

The prioritization of these components is achieved by defining a set of attributes and evaluating each component against the set. These attributes might be strategic importance, financial performance, IT coverage, and so on. Based on the evaluation, the components can be prioritized and a road map developed to achieve the desired transformation. Figure 2 shows a CBM heat map in which the "hot" components are highlighted. Such transformations must address organizational issues involving people, as well as business strategy, processes, and technology issues (such as skills, IT strategy, and application portfolio).

Service-Oriented Modeling and Architecture

As we pointed out earlier, componentization by itself is not sufficient to achieve the desired transformation of the business. The complexity of implementing a componentized business structure can be controlled by designing the various business functions as well-defined services. Thus, the business components interact with each other through the provision and consumption of business services. The success of such an implementation clearly depends on the quality (i.e., fidelity and flexibility) of the underlying IT systems. Here we discuss SOMA, a new technique developed by IBM that holds out the promise of such a high-fidelity representation of the business goals and is also aligned with the componentization technique introduced earlier.

Ideally each business component is supported by a set of IT-enabled services, some of which are specific to that component, while others are shared by more than one business component. In other words, the business component model is completely supported by the underlying, enterprise-scale SOA.

In addition to the business transformation involving componentization, there has to be an IT transformation that aligns the new business structure with the supporting IT systems. The large question that faces the enterprise is how to incrementally accomplish a transformation of the IT system in concordance with the business transformation. The recognition that a service-oriented design is a good complement to the component view of the business leads to the need to define systematically and with

high confidence the services portfolio required for this design. To address this question, IBM has developed the SOMA technique.

Service-oriented modeling is necessary for the creation of an SOA. This modeling takes in the results of the business componentization analysis as inputs (such as scoping of the business-driven IT transformation, partitioning of the business domain, and high-level process modeling) as well as business goals and (KPIs) key performance indicators. The output is an SOA architecture independent of any specific technology that can then be realized using the appropriate technologies.

SOMA starts from the description of the business process to be implemented. The SOMA method consists of three major steps. The *identification* step involves identifying candidate services, candidate enterprise components, and flows. This step exploits a multitude of business analysis techniques (domain analysis and decomposition, analysis of existing IT systems, and the new goal-oriented modeling) in order to identify the collection of candidate services and relate them to the KPIs of the business components.

Next follows the *specification* step in which the services to be exposed are selected and specified. In this step a series of innovative tests are applied to narrow down the initial candidate set to the requisite portfolio of services. The third step, *realization*, involves decisions on how these services will be realized.

The identification and specification steps are carried out by applying one or more complementary techniques, such as variation-oriented analysis and design, subsystem analysis, component modeling, and others. The most important result from the SOMA analysis is the services model, which is comprised of a set of IT services that support the business services and processes and their goals. Additional details about SOMA are provided in Reference 14.

The operating environment

In conjunction with the introduction of the concepts of on demand transformation, IBM has undertaken the definition and development of a new on demand operating environment (ODOE).[15,16] ODOE supports SOA-based solutions and provides an explicit IT representation of business processes. Such representation allows both the manipulation and monitoring of the processes by the business user, thus enabling the change of a process in accordance with the perceived urgency to respond to an external change or event. The operating environment is supported by definitions of processes and services and manipulation tools.[17]

CONCLUSION

In this paper we described our vision of an enterprise that is equipped to cope with the challenges of the new business environment, including revenue growth and flexibility. We discussed the changes needed to transform the enterprise into a service-oriented enterprise, namely componentization, evolving the business ecosystem, changing business processes, and addressing organizational issues. To illustrate the business transformations needed, we described a case study involving a rental car company and showed how componentization and service orientation can enable an enterprise to react quickly to a marketplace need.

The parallel evolutions of businesses and IT raise the new challenge of establishing a tighter linkage between business strategy and IT. IBM is actively pursuing ways to bridge this business/IT gap, and we described the main activities in this area. CBM is a method to develop a componentized view of the business that facilitates its strategic and operational analysis. For mapping the business structure to the IT layer, IBM has developed SOMA. IBM has also developed ODOE, the build and runtime technologies needed to support SOA solutions.

Although the business component model and its implementation technique form a tight structure, there is much left to explore and discover: creating a clear linkage between business KPIs analyzed in CBM and their reflection in the services analyzed in SOMA, strengthening of the criteria and derivations used in SOMA through additional field experience, and tightening the coupling between business and operational considerations in SOMA. The increasing acceptance of the techniques within the IBM Global Services organization and acceptance by selected customers inspire us with the confidence that the business and IT communities will increasingly benefit from the ideas explored here.

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